Green information technology for sustainable development: a case study assessment of the situation in Russia

A. A. Saltan,
PhD in economics, assistant professor
a.saltan@spbu.ru

M. A. Nalobina,
student
m.nalobina@2013.spbu.ru

St. Petersburg state university

It has become increasingly frequent for academic and business communities to fall back on discussing the problem of sustainability. Issues of sustainable development are closely related to the functioning of various industries, including information technologies (IT). The special effect of IT consists of the fact that no business process can be viewed without using IT. In this case, Green IT and IT for Green solutions have proven to be highly relevant, as they cover not only 2% of direct IT influence on the environment but also have a significant impact on other industries accounting for the other 98%. This means that IT can solve sustainability problems not only in their segment but in other segments as well, supporting other technologies and making them greener. The preliminary literature review shows that in Russia, Green IT and IT for Green have never been considered as part of sustainability research while outside Russia the situation is the opposite. Further, the business community demonstrates its interest in this sphere. The overall objective of the research is Green IT studying as an instrument of sustainable development of the companies working in Russia. To achieve this aim, a series of in-depth interviews with the companies' representatives was carried out in which issues of sustainability, their objectives, the possible link to Green IT and IT for Green as well as motivation and restraining factors were discussed.

Keywords: green IS, green IT, environmental sustainability, eco-efficiency, energy efficiency.

Introduction

At the 2015 World Economic Forum, among the ten burning problems humanity is facing, two are at least closely related to environmental pollution and global warming. They are the increase in pollution in developing countries and the growth of the number of natural hazards [23]. Nobody can ignore that these problems are directly related to the rapid scientific and technological development of society and the economy that has been taking place in the ICT sector. In the last few years, the ICT sector has been developing much faster in comparison to other industries and ICT market is continuing to rise irrespective of foreign exchange factors. According to various estimations in 2016, the growth should have accounted for 3% [12]. Such rapid development positively influences the living standards and companies' growth. However, adverse effects also take place, such as energy consumption leading to CO_2 emission, toxic materials being used in production, and the short life cycle resulting in utilization problems [13, 15].

IT market growth has resulted in increased energy consumption that, in turn, is accompanied by the growth of the emission share that happens low-level usage of eco-friendly ways of power generation in the world energy practice. In light of this, the negative influence of IT on the environment is becoming increasingly evident. Still, the IT sector, while creating adverse problems, also suggests ways of solving them. Green IT may well become such an instrument [8, 9]. In the current article, we follow the classical definition of Green IT as «study and practice of designing, manufacturing, use, and dispose of computers, servers, and associated subsystems — such as monitors, printers, storage devices, and net-working and communications systems — efficiently and effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities» [19].

The overall objective of the research being carried out is the study of Green IT as the compound instrument for sustainably developing companies acting in Russia.

This study is based on qualitative analysis and uses three research methods: literature review, design science, and multiple case studies. The rest of the paper is organized as follows. Section 2 provides the literature review and formulates the theoretical basis for further research. A solid understanding of existing literature is required to investigate the research matters thoroughly, to summarize existing research models and approaches, and to formulate relevant case studies questionnaires. Section 2 also provides definitions to the notion of sustainability and its objectives, as well as concepts of Green IT and IT for Green. In Section 3, design science is used to develop a general model for exploring Green IT practice implementation. Section 4 describes the case-study methodology used for conducting research in Russian companies. The study of the various companies based on different data sources is proposed in this research to validate the suggested model and make proposals concerning Green IT as the instrument of achieving sustainable development. Section 5 sums up the implication of the research and discusses limitations of the present study for practical use, as well as directions for further investigation.

1. Background and works related

It should be mentioned that there is no unambiguous interpretation of the term Green IT up to now. From the formal point of view following the classical approach, green systems, products, and production processes are those that are [14]:

- efficient in using energy resources,
- provide recycling or reusable materials and components,
- contribute to reducing the volume of waste and reducing environmental pollution, and
- contribute to the conservation of natural resources.

Under the approach proposed, Green IT is considered only as «environmentally responsible use of computers and their resources». A broader interpretation of the term Green IT considers IT as an integral part of complex solutions that directly or indirectly help to manage problems related to the influence of the impact of human activities on the environment. The solutions related to the

above-mentioned interpretation are called IT for Green. In addition, in recent years, the IT for Green concept has been closely linked to the concept of best available technologies (BAT). The BAT approach involves using the most effective and innovative technologies with significant environmental and energy saving impacts [21]. The relationship between approaches for Green IT and IT for Green with the levels of influence is presented in fig. 1.

Over the past few years, at least three systematic literature reviews on Green IT have been published [2, 17, 24]. The existence of several reviews focusing on the contribution of IT to sustainable development confirms this study's importance. Based on the conducted reviews, the existing literature on Green IT can be divided into several streams:

- incentives and restriction towards Green IT projects;
- Green IT projects development and implementation;
- assessment of benefits and risks derived from Green IT projects.

Studies regarding incentives and restriction towards Green IT usually draw attention to the problem referring to its practical importance and potential value for business and society. Studies on developing and implementing Green IT projects are usually significantly more technical because they focus on issues of new technologies development and how to integrate them into existing operational processes. Studies on evaluating the benefits of implementing Green IT have focused on adopting these technologies and providing empirical data to illustrate the benefits (financial and reputational) that the company can obtain from using Green IT projects.

In Russia, the Green IT and IT for Green movement has never been considered as an important area of sustainability research. We managed to find just four publications in scientific journals written by Russian researchers. Such a small share in the amount of available papers on Green IT worldwide shows almost invisible interest in the study of Green IT in Russia. Two of the identified articles were related to ICT and mass communication development [11, 16]. Authors indirectly mentioned Green IT, referring them as challenging technological trends.

The other two papers focus directly on Green IT issues; however, the authors were interested in general aspects of this scientific domain [22, 25]. The first group of authors considered Green IT regarding possible technological solutions [25], while the other considered these technologies exclusively as a tool for reducing climate risks [22]. Despite the small number of sources mentioned above, the studies allow us to draw some conclusions about the specifics of Russia in the context of the study of Green IT:

Besides the fact that the concept of Green IT had been presented in the Russian scientific community, it didn't receive further interest from the research community regarding performing qualitative and quantitative studies on Russian data.

The current ICT sector development trends involve using Green IT solutions without naming them as such explicitly.

At the same time, the community has demonstrated its interest in this area. Over the past few years, leading

Systemic Impacts
Behavioural Change

Indirect Impacts
Applications

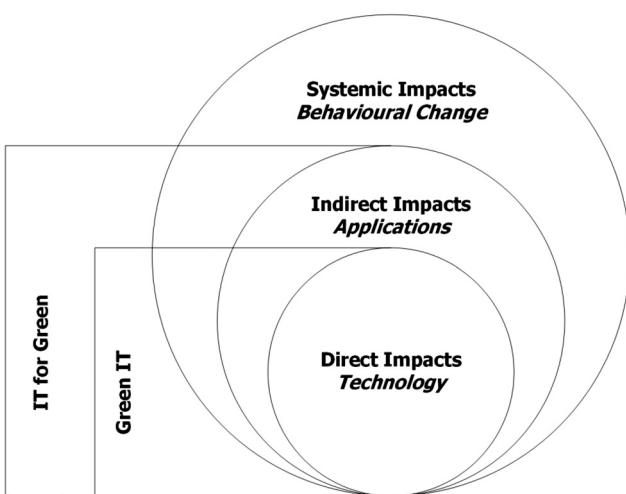**Direct Impacts**
Technology

IT for Green

Green IT

Fig. 1. Green IT and IT for Green (adapted from [10, 20])

industry online magazine CNews has held a series of conferences devoted to the Green IT use by Russian companies [5]. Following the conference, the organizers were forced to admit that the critical issue of interest to the business community is associated exclusively with the possibility of using a given set of green technologies for specific economic benefits primarily related to cost reduction.

Considering the current background related to the situation with Green IT in Russia, we see the necessity of conducting research aimed at understanding how companies acting in Russia understand the notion and importance of Green IT, possible technological decisions, and the problems businesses are facing while implementing Green IT projects.

2. Research model design

The proposed research model suggests the study of the interrelation of key drivers, levels of implementation of Green IT strategies, which influence the selection of specific technological solutions. Within the frames of the model, we consider two points of view on these relationships: first, from the perspective of IT specialists, and secondly, from the viewpoint of the general company management. It's connected with the fact that substantial differences in the points of view on Green IT can be traced in their business routines: the general manager may be less informed of technological decisions while the IT manager may lack the precise understanding of company objectives on the level of economic and institutional pressure. At the same time, the possibility of clustering companies based on their attitude to Green IT practices and overall development level is considered within the model.

Discussing the motivational pressure, we can indicate the following key forces acknowledge empirically: economic pressure related to cost reduction and differentiation; political pressure involving regulatory policies, societal concerns, and employees' attitude; and the perception of «future consequences» of the activities of the companies [1, 3, 18]. The factors occur at various levels of business activity. Some of them are external factors while others are the internal ones.

The influence of the pressure can be seen in the level of implementation of Green IT [6, 7]. However, within the frames of the model suggested, this level is expanded by various views on the objectives of stability and company readiness to determine the precise scope of action. Every business considering its objectives and capabilities may limit itself only by accepting the green policies without following them. Still, however, it can also achieve changes according to the level of the company's sustainable development in the level of human perception. We can also figure out the accidental implementation as the unique level in this hierarchy. As shown by the literature review, the level of awareness of the companies in this area is low. Still, this being so, companies can apply one technological decision being unaware of their green origin.

The degree of implementation of Green IT has an impact on technological solutions, which are divided into two groups: Green IT and IT for Green. Based on the factors presented above, the research model that can be applied to the analysis of the situation in Russia is represented in fig. 2.
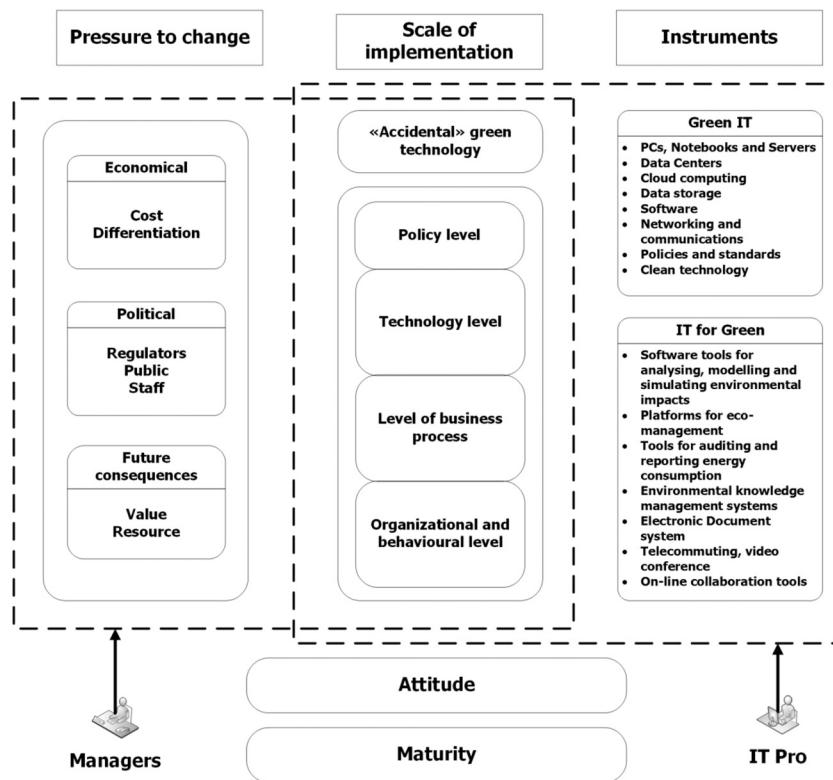

Fig. 2. Research model

3. Case studies

Case studies analysis is widely used in studies relating to IT and «investigates a contemporary phenomenon within its real-life context» [26].

To verify the proposed model and assess the situation with implementing Green IT practices in Russia, a series of case-studies of the use of Green IT in companies conducting business operations in Russia are reviewed. As one of the methods of data collection, semi-structured interviews with both the staff of IT-departments and general managers were conducted.

Considering the research objectives and literature review, we formulated this list of questions for the discussion with companies' representatives:

- How do they interpret the notion of sustainability and its objectives?
- What instrument is used to achieve the sustainability?
- How are Green IT and IT for Green understood?
- What technological solutions have been taken?
- How do they measure the effect on implementation Green IT and IT for Green solutions?
- What motivates and restrains companies when introducing them?

Companies were selected for analysis based on differences in the industry sector, the share of private and public capital, the availability of foreign ownership and size. Information on selected companies is presented in table 1.

After conducting a series of interviews, a cross-analysis was completed, which allowed us to compare and consider different perspectives on the issues under investigation by the representatives of real business. Thus, it is possible to provide a better understanding of the perspective of Green IT in Russia, their uses, and the problems that companies may face while implementing them.

The results of the comparison are presented in table 2. The analysis provides answers to questions about the notion of sustainability, motivation and restraining factors in the implementation of Green IT solutions. Each question was based on detailed information received from company employees.

The differences between these cases in the framework of businesses are observed in almost each of the research questions. However, most the differences boil down to scales of assessment and implementation of green technologies (see table 2). However, it is important to note that companies agree that Green IT and IT for Green are proper tools that can be used for businesses' sustainable development.

Besides significant differences of views on sustainable development and Green IT, we can trace similarities in the companies' approaches:

- Both companies believe that Green IT can be taken as instruments of development. Still, their low-level professional awareness of the matter can limit its implementation.
- The technological implementation does not take place within a sustainable development strategy, with all the examples of Green IT being accidental.

Based on the results received and additional information about companies, several assumptions on the particularity of developing IT technologies in the companies working in Russia can be introduced:

Assumption 1. Choosing the most relevant aspects of sustainability determines the implementation level of Green IT and its indicators when selecting the technologies.

Assumption 2. The IT role depends on the degree of maturity of the IT department: the higher it is, the more it is likely that IT staff will set business tasks and initiate the implementation of Green IT projects.

Assumption 3. The type of the technologies introduced is linked with IT roles and the sustainability strategy.

Assumption 4. The availability of sustainability strategy defines the approaches to the efficiency assessment and the level of importance of non-financial factors in decision-making.

Assumption 5. The factor of future consequences is likely to be more important in case the company is big, financially stable, and developed.

Assumption 6. For Russia, the introduction of Green IT often bears the accidental character, which can be explained by the low level of awareness of Green IT, lack of implementation experience, and the absence of governmental initiatives.

Conclusion and Discussion

A major factor of the weak demand in Green IT in Russia is the lack of legislative incentives, as well as an understanding of social responsibilities. Quite often, companies do not have a long-term planning horizon that affects their willingness to evaluate current solutions regarding far-reaching consequences and development. Most Green IT Projects can only be recouped in 10-15 years in a stable economic environment. The absence of legislative initiatives as well as the insignificant level of companies' interest in implementing Green IT in Russia leads to a lack of interest in the academic community to perform qualitative and quantitative studies on Russian data. Meanwhile, this research could serve as an incentive for further developing Green IT in Russia (like the one for China [4]) by exploring best practices that can be implemented.

Table 1

Characteristics of the companies involved in the study

Characteristics	Case A	Case B	Case C
Industry	Retail	Food and Beverage	Machinery Manufacturing
Size	Medium	Large	Large
Ownership	Russian Private Company	Foreign Private Company	Russian State Owned Company
Interviewees	CIO, CEO	CIO, Head of Analytical Department	Head of IT Department, Head of the Strategic Development Department

Table 2

Comparative analysis of case studies

	Research question	Case A	Case B	Case C
How do companies understand the concept of the sustainable development?	Are they familiar with the notion of sustainable development?	Yes	Yes	Yes
	How do they implement this concept within the company? What aspects are the most important (financial, social, environmental)?	Financial aspects are the ones taken into account	Considered as the value of the company, and covers all three aspects	Financial aspects are the ones taken into account
	Do they have a formalized strategy?	No	Yes	No
	Do they have reports on its implementation?	No	Yes	No
How companies associate sustainability and Green technologies?	Do they have a clear vision of these technologies?	Yes	Yes	Yes
	Could these technologies be considered as sustainable oriented?	Yes	Yes	No
	Is it possible to achieve sustainability without the use of IT?	No	No	Yes
What technological solutions can be considered as Green IT solutions?	What is the role of IT?	Business support	Business support, in some cases, offer new challenges	Business support
	Do they have any Green IT solutions in the company?	Yes	Yes	Yes
	Do they use Green IT and IT for Green solutions to achieve sustainability?	Yes	Yes	Yes
	What is the primary objective of implementing Green IT projects?	Cost reduction: making IT usage more energy efficient and business processes optimization	Business processes optimization, sustainability	Accidental implementation
	What factors are taken into account while making the decision on the implementation?	Financial	Both, financial and non-financial ones	None
What approach is used to measure the effect of Green IT projects implementation?		Changes in costs	Key indicators in the framework of the sustainability strategy	None
What are the main motivation and restraining factors?	Motivation factors	Economic factors (cost reduction), institutional (legislation, social responsibility)	Economic factors (cost reduction), institutional (social responsibility), «future consequences» factors	None
	Restraining factors	Lack of government support, focus on a single factor of stability at a particular stage of development	Lack of understanding of the concept of Green IT as a tool to achieve sustainability, a focus on individual aspects of sustainability	Lack of government support, concentrate on a single factor of stability at a particular stage of development

The above-presented analysis brings to the conclusion that the model developed is correct and can be applied to the study on a larger scale and to formulate basic hypotheses to be tested. Further studies based on the proposed approach will enhance the understanding of the applicability of Green IT in Russia. Analyzing the results obtained in the research conducted, we can confirm that environmental factors of Green IT seem less interesting to business in comparison with technological and economic ones. Still, as in the case of energy efficiency, given the competent state policy, companies will be ready to implement such projects to improve eco-efficiency. This being so, it is possible that environmental sustainability will be primarily achieved through other, more trivial ways, such as separate waste collection and recycling. Still, industries exist in which society can stimulate interest in ecological issues.

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«Зеленые» информационные технологии как инструмент устойчивого развития: оценка ситуации в России на основе кейс-анализа

А. А. Салтан, к. э. н., ассистент.
М. А. Налобина, студент.
(Санкт-Петербургский государственный университет)

К настоящему моменту обсуждение проблемы устойчивого развития стало неотъемлемой частью дискуссий в академических и деловых кругах. Причины возникновения проблем устойчивости связаны с деятельностью многих отраслей включая информационные технологии (ИТ). Особенность ИТ состоит в том, что в настоящее время без них сложно представить бизнес-процессы практически любого характера. В связи с этим ценность предлагаемых решений проблемы устойчивости в виде «зеленых» ИТ (Green IT) и ИТ для обеспечения экологической устойчивости (IT for Green) представляется в том, что охватываются не только 2% влияния на окружающую среду непосредственно ИТ, но и влияние остальных сфер деятельности, составляющее оставшиеся 98%. То есть ИТ способны решать проблему устойчивости не только в своем сегменте, но и в других, являясь «поддержкой» других технологий, делая их более «зелеными». Кроме того, интерес бизнеса также очевиден, о чем свидетельствует в том числе разнообразие рейтингов компаний с точки зрения уровня воздействия на окружающую среду. Целью проводимого исследования является изучение «зеленых» ИТ как комплексного инструмента устойчивого развития в компаниях, ведущих свою деятельность в России. Для достижения поставленной цели была проведена серия глубинных интервью с представителями компаний, в рамках которых были обсуждены вопросы устойчивого развития в целом, возможные связи устойчивого развития и «зеленых» технологий и факторы, стимулирующие и ограничивающие компании при внедрении «зеленых» ИТ.

Ключевые слова: «зеленые» ИС, «зеленые» ИТ, экологическая устойчивость, экоэффективность, энергоэффективность